25 YEARS OF STORAGE BATTERY BUILDING

1888 1913

THE BUILDING UP OF AN INDUSTRY

HOW IT BEGAN AND WHAT IT HAS ACCOMPLISHED IN TWENTY-FIVE YEARS

1888 <E C S B> 1913

THE HISTORY, THE PRODUCT
THE FACTORY AND THE MEN
OF

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

Foreword

TOWARD the close of the year 1887, a Frenchman, Clement Payen, came to America with the firmly established notion in his head that he had invented a storage battery which was radically different from, and immensely superior to, all the then existing types.

And there were certain far sighted individuals in Philadelphia so strongly impressed with the force of his arguments that they thereupon secured from him by purchase the assignment of all his patents and patent rights.

Within a very few months a company was formed, a factory secured, manufacturing was started and steps had been taken to exploit the new storage battery under the trade marked name of the **"Chloride Accumulator".**

This registered trade mark has since become so identified with storage battery practice, both here and abroad, that, to use a hackneyed phrase, "you cannot speak of the one without thinking of the other." The term **"Chloride Accumulator"** has become synonymous with the highest type of storage battery practice; it is the "sterling" mark of perfection in storage battery installations.

This, briefly, is an outline of what led up to the organization of The Electric Storage Battery Company on June 5, 1888.

As the year 1913 marks the "Silver Anniversary" of the Company, it is thought quite fitting to indulge in these reminiscences and place them on record, as it were, in this souvenir book.

The history of storage battery development in this country is practically the history of this Company.

It might, perhaps, be more correct to reverse that statement, this Company always having been in the forefront, not only in the perfecting of the battery in its electrochemical and mechanical

features, but it has been the pioneer in successfully demonstrating the value of its application to the many new and rapidly multiplying fields of applied electricity.

When one sees the enormous batteries which this Company has built and installed for lighting and power service, and which are now considered essential to the reliable working of these plants, it is difficult to realize that only twenty-five years ago many electrical engineers spoke of the storage battery disparagingly as being an "interesting laboratory experiment" or "a cloak for poor engineering," but from a commercial standpoint not to be considered seriously.

These quotations now only provoke a smile, but it was a serious undertaking in those early days to convince these incredulous engineers.

This Company had to PROVE its battery to be of immense service as an adjuster of varying load factors and DEMONSTRATE its reliability as a "watch dog" against temporary breakdowns in case of derangement of the generating or distributing apparatus.

It is therefore hoped that this short review of the past will prove interesting, illustrating as it does, not only the changes that have occurred in manufacturing processes, but the important part the Company's work has played in the electrical world.

1888 <E S B> 1913


Herbert Lloyd
PRESIDENT AND GENERAL MANAGER
1888–1913

1888—1913

The Electric Storage Battery Co.

The History

GLOUCESTER, N. J., is a small town on the banks of the Delaware River, a few miles below Philadelphia. On the outskirts of this town, in a small one story building, a picture of which is shown on the top of Plate IV, this Company, in the year 1888, began the manufacture of the famous "**Chloride Accumulator**".

The mould for making the first battery plate manufactured by this Company was completed on Decoration Day, 1888.

The number of men employed in this Gloucester factory when work first started totaled five. This included workmen, chemists and engineers. And, although it is a matter of inside history, a visitor at that time would have had difficulty in distinguishing the technical experts from the hired laborer, as the entire force in those days worked with both brain and muscle to overcome the many obstacles which are discouragingly frequent in the development of almost all great manufacturing processes.

Today a multitude of workmen are employed in the manufacturing departments of the works at Philadelphia, which are equipped with perfected labor saving devices capable of turning out more material in an hour than scores of men could have completed in a week in the early days of battery building.

Much could be written about those first few years of manufacturing and how obstacles and prejudices were overcome in securing for the storage battery its acceptance by the electrical engineering fraternity as a reliable and invaluable adjunct to power house plants.

It is frankly acknowledged that, as compared with the present state of the art of battery building, many of the details of construction at that time were imperfectly worked out, and were seized upon by the skeptically inclined, distorted and magnified into arguments

showing the storage battery "innovation" to be unreliable and impracticable.

The interesting reproductions of plates and batteries of the past as compared with present day standards shown in Plates I, II and III will illustrate this point better than any written explanations. The pictures, however, also show clearly that the foundations upon which this Company built were bed rock upon which have been erected the giant installations of today.

But it would go beyond the confines of this brief history to dwell on these points or to enumerate the many small installations which marked the first few years of this Company's business. Mention should be made, however, of an interesting experiment in storage battery street car operation which marked this period. In 1890, The Lehigh Avenue Railway Company, of Philadelphia, ordered 1,300 cells of the "Chloride Accumulator" to be used in the equipment of six cars built for operation on this road.

Much valuable data was gathered from this experiment in storage battery traction and also from a later one made in 1893 by The Metropolitan Railroad Company, of Washington, D. C., on which occasion the "Chloride Accumulator" was tried in competition with several other makes of batteries. It is noteworthy that it was the only one to secure the indorsement of the engineers conducting the test.

The inherent merits of the "Chloride Accumulator" acknowledged by a few prominent electrical engineers from the very outset, were now beginning to be recognized by many others and from the year 1892, what were considered in those days important ventures in storage battery practice, began to attract the attention of the electrical world.

In August, 1892, a battery was placed in The Provident Life & Trust Building, at Fourth and Chestnut Streets, Philadelphia, to care for the night lighting and elevator loads. The first installation consisted of 448 cells arranged in 8 series of 56 cells each, connected in parallel. The purpose of this arrangement was to secure the large total capacity required from the small capacity cells which were then available.

This battery was operated successfully for two years and then replaced by an installation of larger cells which The Electric Storage Battery Company had subsequently developed.

Numbers of other plants for isolated lighting and power followed this installation.

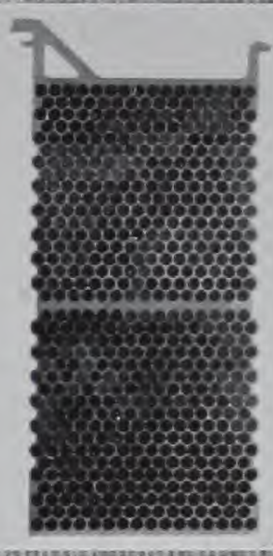
In 1894, a battery was built and installed by this Company for The Germantown Electric Light Company, of Philadelphia. It consisted of 130 cells of 800 ampere hours capacity, installed in

PLATES AND CELLS OF THE PAST AND PRESENT

IN LIGHTING AND POWER STATIONS

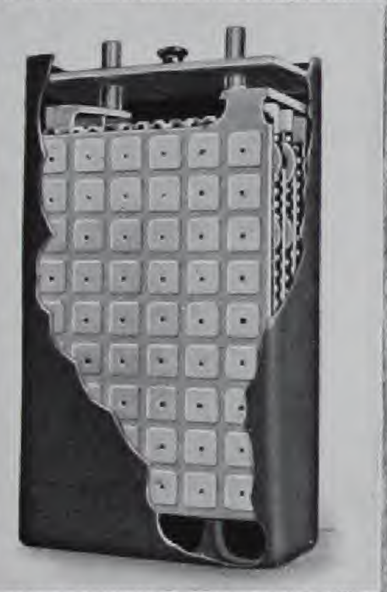
THE "CHLORIDE" POSITIVE PLATE 1888

THE "EXIDE" STAND BY POSITIVE PLATE 1913



THE "MANCHESTER" TYPE H POSITIVE PLATE 1913

IN ELECTRIC VEHICLE SERVICE

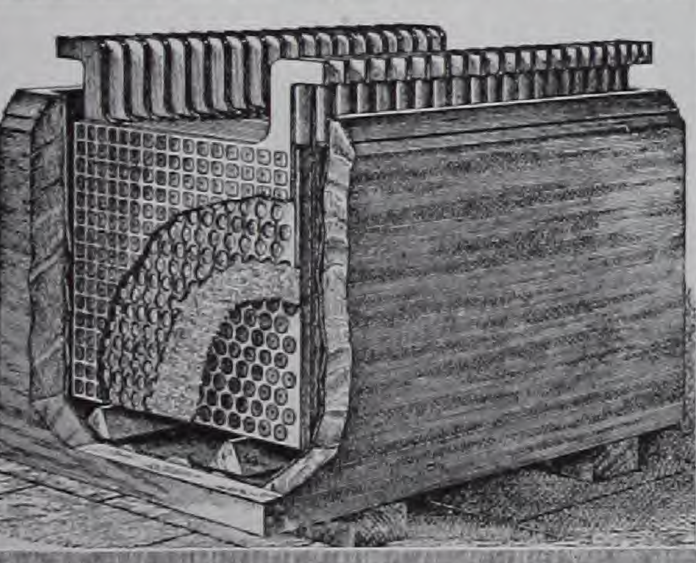


M V "CHLORIDE ACCUMULATOR" CELL 1898

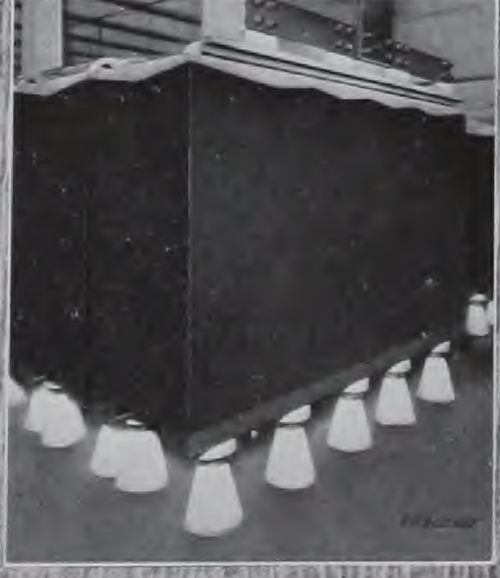
M V "EXIDE" CELL 1913

M V "IRONCLAD EXIDE" CELL 1913

IN CENTRAL STATION SERVICE

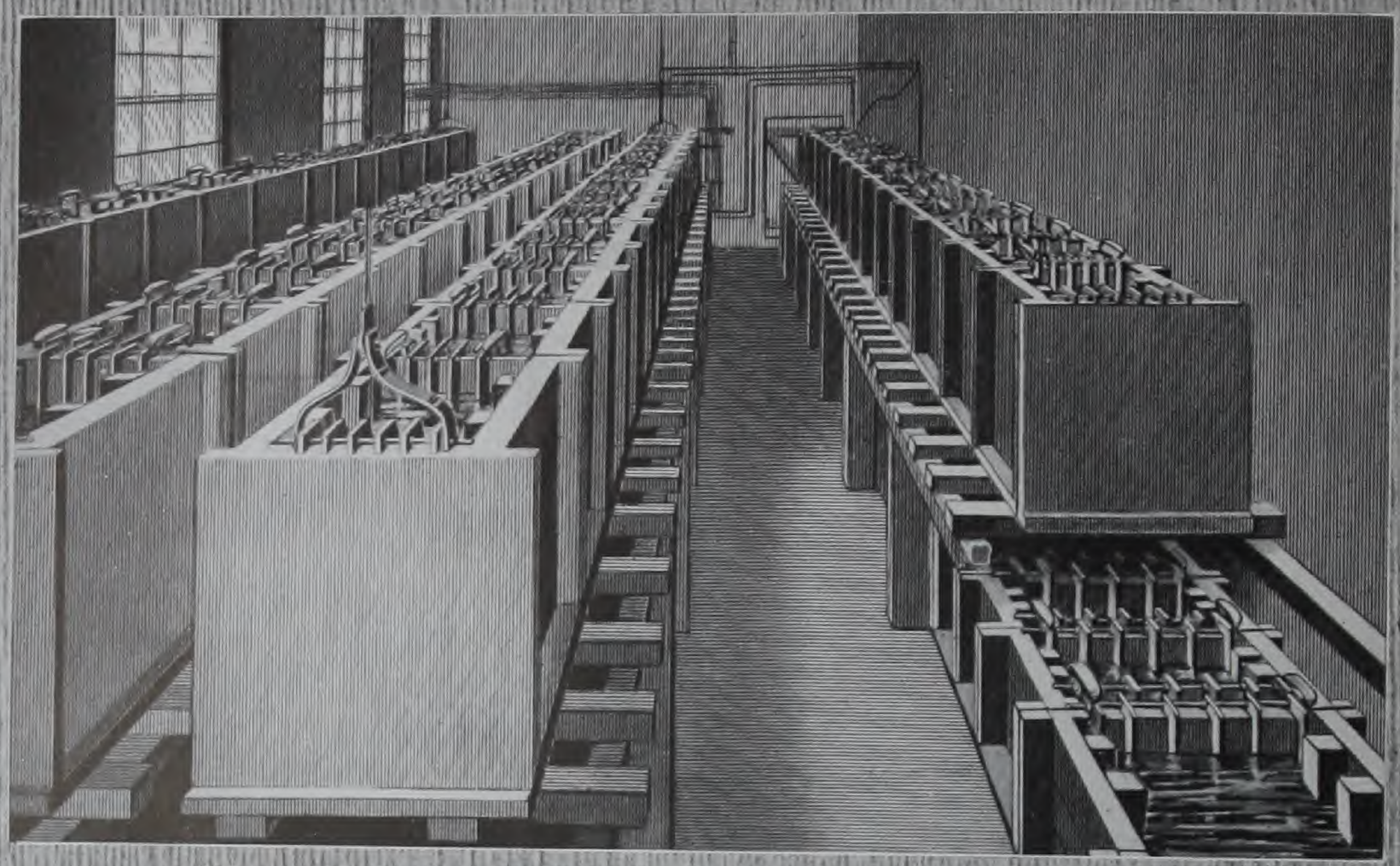


A CENTRAL STATION CELL OF 1892

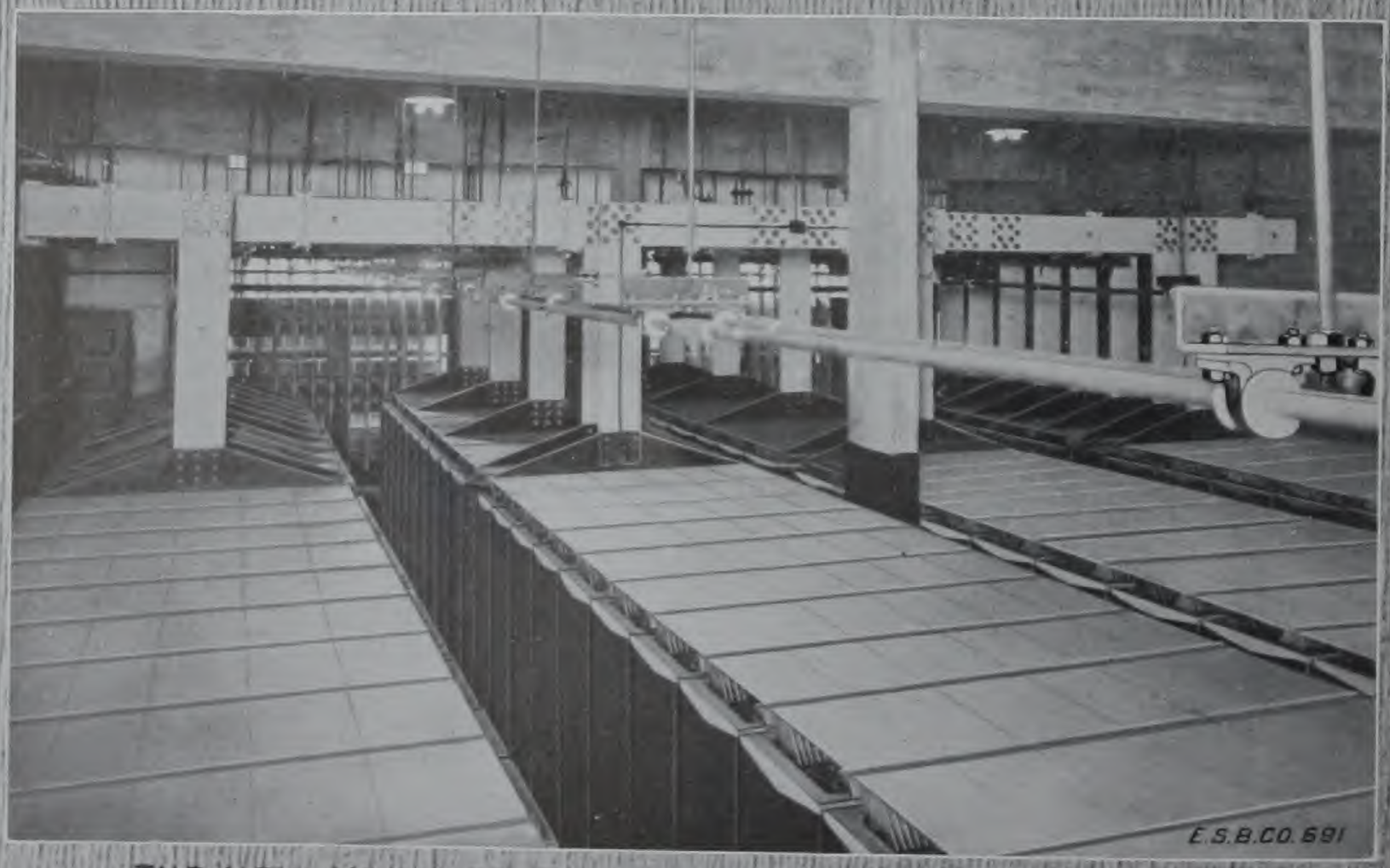


A CENTRAL STATION CELL OF 1913

CENTRAL STATION BATTERIES OF THE PAST AND PRESENT



GERMANTOWN ELECTRIC LIGHT CO. BATTERY - 1894



THE NEW YORK EDISON CO. 60TH ST. BATTERY - 1913.

lead lined wood tanks. It was used to care for the day load on the lines, being charged between midnight and 6 a. m.

The illustration given of this installation in Plate II shows the peculiar tank construction and the absence of insulation. As previously mentioned, these details were speedily perfected, the first steps being seen in the picture of the first New York Edison Company battery shown on Plate III, which was built in the following year. Here it will be noted glass insulators are installed and a change made in the method of constructing the lead lined tanks.

The year 1895 was notable in that it marked the beginning of this Company's immense development of the application of storage batteries to large central lighting and railway power services. In this year, the first large batteries made in America for central lighting and power station work were built and installed for The New York Edison Company and for The Electric Light & Railway Company, of Merrill, Wis.

The New York Edison Company, it should be noted, holds not only the distinction of being the first to install the "**Chloride Accumulator**" in its stations, but also that of being the possessor of the greatest number of storage batteries and of the largest individual capacity batteries operated by any one company.

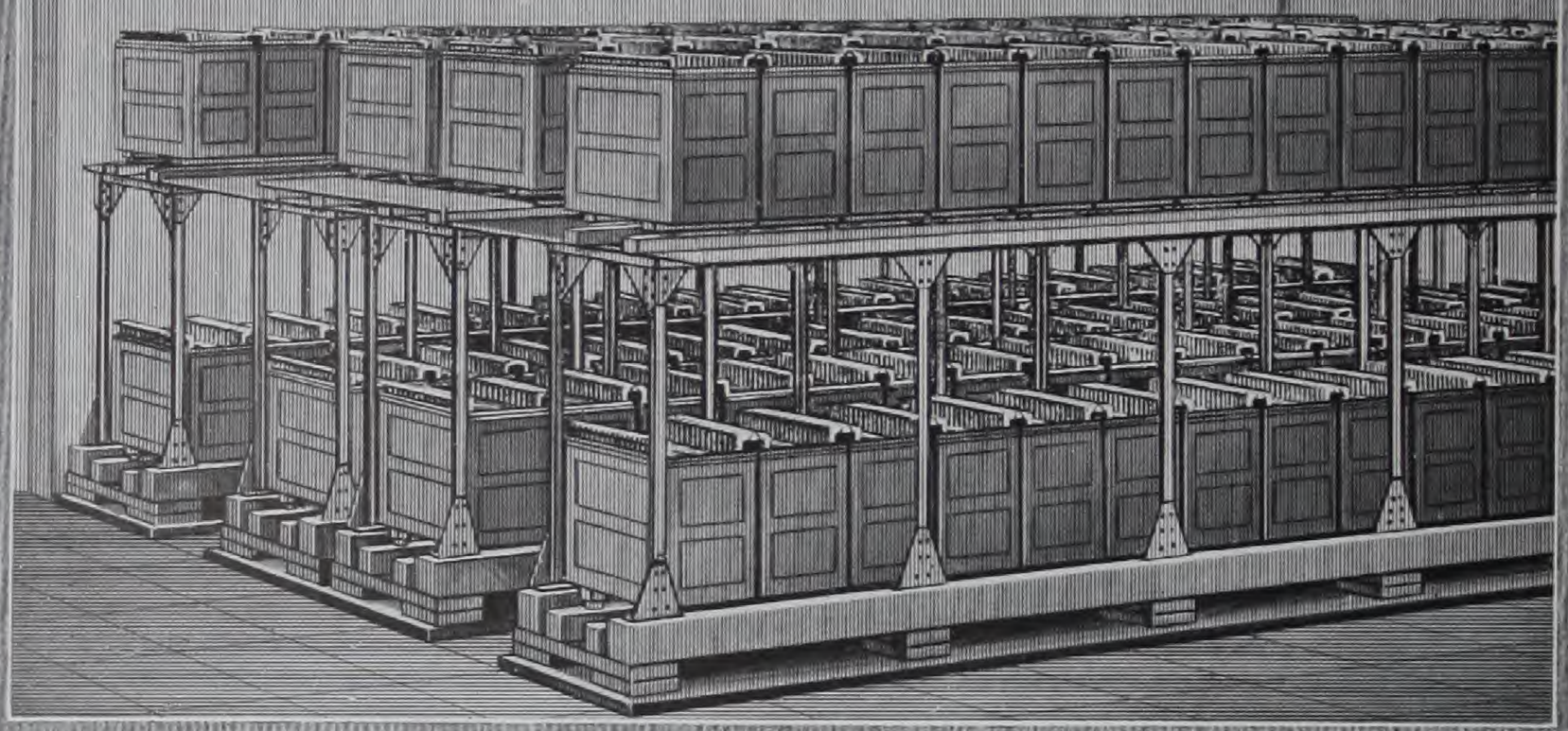
As these central station installations are mentioned in another section of this book, it need only be briefly stated that other large battery plants followed in quick succession, for the Brooklyn Edison, Hartford Electric Light, Boston and Chicago Edison and many other central station and electric railway companies.

In 1894, the Company had taken steps toward the acquisition of basic storage battery patents and the patent rights of a number of smaller companies who had engaged in the manufacture of accumulators. Constant patent litigation had so hampered the development of the industry that it was found wise to take this action, which practically secured to itself at that time the sole right to manufacture storage batteries in this country.

Previous to this, an alliance had been formed with the three largest foreign battery manufacturers—The Chloride Electrical Storage Syndicate, Limited, of Manchester, England; the Accumulatoren-Fabrik Aktien-Gesellschaft, of Germany, and the Société Anonyme pour le Travail Électrique des Métaux, of France. As will be readily appreciated, the interchange of engineering ideas and manufacturing details thus obtained greatly facilitated the development of the Company's product.

One of the earlier important advantages of this alliance was the assignment to this Company of the American patents on the "Tudor"

CENTRAL STATION BATTERIES OF THE PAST AND PRESENT



FIRST STORAGE BATTERY IN 12TH ST. STATION. EDISON ELECTRIC ILLUMINATING CO. NEW YORK.

CONSOLIDATED GAS ELECTRIC LIGHT & POWER CO. BALTIMORE.

and "Manchester" positive plates, the former being manufactured in Germany and the latter in England. These types of plates had established an enviable reputation abroad in all classes of storage battery service.

Both of these plates have been adopted by the Company as standard types of construction, the "Manchester" plate having entirely superseded the original "Chloride" positive.

From the German company, in 1901, was also secured the famous "Box Negative" plate which has proved to be an invaluable acquisition to this Company's manufacturing rights.

In the meanwhile, the rapid development of the Company's business had necessitated the securing of larger manufacturing facilities, as the enlarged Gloucester plant had by this time become inadequate to handle the work. In 1894 the Company secured the basement and the first floor in one of the wings of the large Warden Power Building, located on Allegheny Avenue, 18th to 19th Streets, Philadelphia, at which place, with greatly enlarged space and excellent shipping facilities, the manufacture of the **"Chloride Accumulator"** continued on an increasing scale.

From time to time additional floors of this building and specially built structures were added to the plant. But appreciating the fact that, immense as the Warden Power Building was, its entire floor space would soon be required by the growing needs of the various manufacturing departments, negotiations were started to purchase the entire plant.

In January, 1904, the Company became the possessor of the entire group of buildings, and felt reasonably assured that it had amply provided for both its present necessities and its future growth.

The steadily increasing sale of its batteries, however, soon proved the fallacy of this assumption—but of this later.

The electric vehicle industry, which today has become through its inherent merit a large and rapidly growing one, owes no small measure of its success to this Company's broad minded and intelligently directed pioneer work. For when electric vehicles were in their developmental stage, this Company's engineers and this Company's batteries were employed in the preliminary experimental work which has resulted in today's perfection of this type of pleasure and commercial car.

In 1896 the developments of the electric vehicle gave indication of becoming a prosperous industry. This Company, anticipating the demand which would be created for a special type of battery which should combine lightness with strength and capacity with durability,

began the most careful study of all the factors entering into this new field of battery service.

With the conservatism and minute analysis which is characteristic of this Company's attitude toward all new developments, after exhaustive tests and large expenditures, it perfected and placed on the market in 1900 the "Exide" Battery.

It is permissible to state here, and the statement cannot be controverted, that no vehicle battery has ever secured such a wide spread distribution or demonstrated such uniformity of excellence in actual service as this well known type. Its name has become inseparably associated with the "Electric," and, as suggested before, the "Exide" Battery is largely responsible for the popular success of the electric vehicle.

Later developments in batteries for electric vehicle service placed on the market, in order—the "Hycap-Exide", the "Thin-Exide" and finally, in 1911, the "Ironclad-Exide", which latter has earned for itself an unassailable reputation.

In fact, these vehicle batteries, like the other batteries manufactured by this Company, predominate their fields today and are recognized as the standards for their particular classes of service.

Aside from this development of specially designed batteries for electric vehicle service, the Company, in February, 1909, emphatically demonstrated in another way its great service to the industry, by a carefully planned and executed advertising campaign on electric vehicles directed to the central station companies throughout the country. Its aim was to awaken their interest in a development which meant so much to them, opening as it did a new and most profitable source of income.

One has only to go back to files of the electrical engineering publications during 1909 to find the novel and forcible advertising which this Company used to lay before these lighting and power stations the opportunities for business which lay in the development of the use of the electric vehicle.

A series of booklets were printed especially for the consideration of the central station manager. Their object being to awaken his interest in the electric vehicle situation; to show him how, by promoting the use of electric pleasure and commercial vehicles, he would be the largest gainer, as their increased use meant an increased and permanent income to his station.

Several of the Company's series of "bulletins" were devoted to this subject, and a score of letters forwarded to thousands of central station managers urged them to "boost" the "electric," showing them that the very nature of the business was peculiarly valuable

to them, inasmuch as it frequently represented the transformation of an unprofitable load upon their stations to a most profitable one.

This campaign, carried on for several years, was most broad gauged. Without attempting to disguise the fact that the increased use of "electrics" meant a large preponderance of the increased battery business being absorbed by The Electric Storage Battery Company—the propaganda was nevertheless designed so as to benefit the electric vehicle industry and the central station companies equally. There were no strings tied to the scheme and the "Exide" Storage Battery was, from an advertising standpoint, kept in the background for an extended period.

In close relation to this campaign, it is worthy of note that this Company, in March, 1909, by its own efforts, and at its own expense, instituted the formation of a union of interests between the vehicle manufacturers and the central station companies, the object being to push, by extensive advertising, the popularity of the electric commercial and pleasure vehicle.

For this purpose, on its own initiative, in 1910 it secured from many central station companies and electric vehicle manufacturers a subscription fund of considerable size, which was subsequently turned over to the then recently formed "Electric Vehicle Association of America."

In its last annual report, the Association acknowledged this pioneer work in the following words:

"This Association cannot lay claim to the distinction of having originated the idea of a national co-operative advertising campaign for the promotion and sale of electric vehicles. To The Electric Storage Battery Company, which fathered, and to other battery and accessory manufacturers, central station companies and vehicle manufacturers who joined in this movement, must be accorded the honor of initiating the idea of a co-operative educational publicity campaign of this nature."

The application of the "Exide" plate to central station service marked a new era in this field of engineering.

When storage batteries were first used by the large light and power stations, the principal object of their employment was to secure an economy in the operation of their steam power equipment.

The heavy but comparatively brief peak loads thrown on the station in the early hours of evening necessitated the employment of additional generating apparatus and additional engine and boiler capacity to meet this short, heavy demand for current.

The use of storage batteries satisfactorily solved this problem and, as was quickly found, added an insurance feature of great value,

in being able to care for the entire load on the system for short periods when temporary derangements to machinery threatened a suspension of service.

The insurance feature of battery service has now become paramount, so that the present huge installations of the "Exide" type are depended upon mainly to furnish for emergency service a tremendous output and are maintained in the central stations principally for this purpose. They are dubbed the "watch dogs of the system." The first battery of the "Exide" type was installed for The New York Edison Company in 1908.

The rapid growth of the electric vehicle industry and the multiplications of fields for storage battery application again confronted the Company with the necessity for securing additional manufacturing facilities. To meet this requirement, it contracted in 1911 for the erection of an immense six story concrete addition to its group of buildings—the new building being the largest of this form of construction in Philadelphia.

With this distinctly modern annex, the Company's plant is now the most complete and the largest in this country devoted exclusively to the manufacture of storage batteries and their accessories. There are in all twenty-three separate buildings now occupied, the floor space in the buildings alone amounting to over 12¼ acres.

Tracks from both the Pennsylvania and Reading Railroads are run directly into the buildings and yards and loading platforms are placed in different portions of the works to facilitate the handling of the incoming bulky, raw materials and the outgoing finished products.

The plate opposite reproduces pictures of the immense plant taken from three different viewpoints.

With the rapid growth of the business, it was found necessary to broaden the scope of its force. The multiplication of large installations and the diversity of applications demanded not only an enlargement of its corps of engineers and salesmen at the general offices and works, but also their location at strategical points throughout the country, so that men trained in storage battery practice should be readily available.

To meet this demand, sales offices—early established in New York and Boston—were placed in Chicago, Baltimore and San Francisco. Each of these offices carried its own sales, engineering and operating staff. These were added to until at the present time thirteen sales offices in the United States, one in Canada (with sub-offices) and its general offices in Philadelphia represent the Company in fourteen chief cities.

ORIGINAL FACTORY
AT GLOUCESTER, N.J.

PRESENT WORKS VIEW
FROM NORTH EAST

PRESENT WORKS VIEW
FROM SOUTH EAST

BIRDS EYE VIEW
OF PRESENT WORKS

The location of "Exide" Depots throughout the country was also found imperative to care for the enormous development of the electric vehicle business.

The "Exide" Depots carry a force of trained battery men who, with a store room of manufactured plates and parts at their command, assemble the various types of electric vehicle batteries, ignition, starting and lighting batteries and the small stationary batteries for isolated lighting plants.

An important portion of the business of these depots is that of looking after renewals and taking care of battery repair work in the electric vehicle field.

These depots have grown in some localities from small rented quarters to large warehouses for the "Exide" types of batteries. This is interestingly shown on Plate V, where the illustrations of the Chicago, Cleveland and Boston Depots of the past and present are shown.

The depots in order of establishment are located in New York, Chicago, Boston, Cleveland, San Francisco, St. Louis, Denver, Kansas City and Atlanta.

The service organization of the Company is unsurpassed, as will be seen by reference to the map shown at end of book. The scope of the Company's operations will perhaps be more readily appreciated by a study of this diagram and the data attached than by any further statements which could be made.

The distribution of the Company's product by the fourteen sales offices and nine "Exide" Depots is assisted by over 1,000 distributors, thus extending the Company's business into practically every locality in the United States.

It is a safe claim to make that there is not a principal town in the United States where the Company's goods are not in use, and where its distributors cannot be found.

In 1902, the Company instituted the practice of calling together a general convention of its force at stated intervals in Philadelphia.

On these occasions, the managers of the various sales offices, the district engineers and the principal salesmen meet the Company officers and headquarters staff for the purpose of a general discussion as to the best methods for handling and further developing the Company's business.

Papers are prepared and read by officers of the Company, sales managers, engineers and department heads. Morning, afternoon and evening sessions are held, the conventions generally lasting a week. This interchange of ideas and the discussion of matters of

"EXIDE" DEPOTS OF THE PAST AND PRESENT

FIRST CHICAGO EXIDE DEPOT

PRESENT CHICAGO EXIDE DEPOT

FIRST CLEVELAND EXIDE DEPOT

PRESENT CLEVELAND EXIDE DEPOT

FIRST BOSTON EXIDE DEPOT

PRESENT BOSTON EXIDE DEPOT

Plate V

STAFF OF THE ELECTRIC STORAGE BATTERY COMPANY
IN CONVENTION AT PHILADELPHIA, NOV. 6TH TO 10TH, 1911

DINNER GIVEN BY THE ELECTRIC STORAGE BATTERY CO.
TO THE ELECTRIC VEHICLE MANUFACTURERS DEALERS AND "EXIDE" DISTRIBUTORS
MID-DAY CLUB, CHICAGO, FEBRUARY 5TH, 1913

vital interest to the entire force have proved to be of great and lasting value to the Company.

For on these occasions definite policies are formulated, engineering details are discussed, new types of batteries and new apparatus and accessories are shown and explained to the managers, engineers and salesmen of outlying territories, so that, upon their return to distant headquarters, they are made thoroughly conversant with proposed new methods of construction and improved processes.

A group picture of those attending the 1911 convention is shown on the opposite page.

At frequent intervening periods meetings of the branch sales office managers are held for the purpose of conference on matters specially pertaining to the sales department.

There is an interesting feature of the Company's policy which should be mentioned here as it is closely allied to the development of its manufacturing, operating and construction departments. It also explains why the Company has at its command so many experienced men familiar with its manufacturing processes and why it has also been able to furnish to central station companies and others men trained to intelligently supervise the care and operation of storage batteries.

This has been accomplished by the development of what may be called its cadet corps. Young men who possess the essential requirements—a desire to study the battery business in a thoroughly practical way and a determination to "get ahead"—are given every encouragement and are carefully instructed.

After going through the manufacturing departments and learning by actual daily work, with limitless material, the minutest details of battery construction, those who have the right material in their own make up are frequently found capable of commanding positions of responsibility in establishments where batteries are handled in large quantities.

It is noteworthy that among those who hold important positions today in this Company, as well as in central station and electric railway companies, and in the large electric garages throughout the country, there are a great many who have secured their knowledge of practical storage battery engineering in the works of this Company.

This in brief outline is the history of this Company's growth from the time that Clement Payen and his idea arrived in this country to the present writing.

But something more than a new process for making storage batteries was responsible for the wonderful growth of this Company.

The knowledge and ability to direct the operations of manufacturing upon a large scale a product complex with technical intricacies—the selecting of engineering talent and men of scientific attainment peculiarly qualified to handle these problems—the training and guidance of those occupying responsible executive and commercial positions in the Company's affairs—the progress of the Company, its development and success, centers in its President and General Manager, Mr. Herbert Lloyd, who for twenty-five years has, with rare judgment, business sagacity and knowledge of men, together with an unceasing personal interest in the welfare of all, cemented together an organization unified by his example and spirit of loyalty to The Electric Storage Battery Company.

1888—1913

The Electric Storage Battery Co.

The Product

IT is most interesting to note not only the diversity of fields of service in which the products of this factory are used, but also the number of generally unthought of applications.

A rather flexible imagination is required to associate the cheerfully lighted interior of a Western farm house and the roaring starting of a hydroplane engine with the same source of energy.

The batteries manufactured by this Company not only propel numberless electric launches and light hundreds of palatial yachts on the surface of the water, but they are used in the submarines of our Navy for propulsion when these boats sink beneath the surface.

Through the night air, from a sinking ship, Jack Binn's famous wireless call for help was made possible by the current supplied from a few cells of the **"Chloride Accumulator"**, and there are mines deep in the bowels of the earth where these batteries have long been in daily use—if such a term can be applied to a place where night is perpetual.

On the country roads or city highways at night, the dazzling glare of countless automobile headlights announce the fact that there are a hundred thousand autos throughout these United States whose power for lighting, ignition and cranking is furnished from a type of battery devised and manufactured by this Company for such service.

On the iron highway, the cars in which one rides are lighted electrically, and the approaches to large terminals are guarded by numerous semaphores and interlocking switches, operated by the **"Chloride Accumulator"**.

In summer homes by the seaside, in suburban dwellings and on isolated farms far from central lighting and power service, current from

battery installations made by this Company transform primitive into modern methods of illumination—change inconvenience into luxury.

Electric trucks and pleasure cars, as they pass by in daily increasing numbers, tell the same story—"The **"Exide"** Batteries made us possible."

It will, therefore, be readily appreciated how large a task it would be to more than outline the work done by this Company in such widely varied fields; for it would require many pages to enumerate even by name the installations made by this Company for central lighting and power stations, electric railway power houses and substations, office buildings and other large isolated light and power plants.

The magnitude of its operations and the wide distribution of its product is, therefore, merely suggested. The output of all the special types of batteries manufactured by this Company for various services, if it could be aggregated and resolved into a unit of kilowatt hours capacity, would make a stupendous total.

Mentioning, therefore, only the principal services to which this Company's batteries have been applied, we find them installed for and used in:

Central Lighting and Power Stations.
Electric Railway Power Houses and Substations.
Municipal and Office Building Lighting and Power Plants.
Steel Mills.
Lighting and Power Plants for Hotels and large Apartment Houses.
Electric Hoists and Elevators.
Suburban Residential and Farm Lighting Plants.
Railway Interlocking Switch and Signal Service.
Railway Car Lighting.
The Electrification of Railway Terminals.
U. S. Government Submarine and Gun Firing Service.
Telephone, Telegraph, Wireless and Fire Alarm Service.
Laboratory and Small Motor Work.
Electroplating.
Automobile Starting, Lighting and Ignition.
Stationary Gas Engine Ignition.
Yacht Lighting Plants.
Electric Launches.
Electric Commercial and Pleasure Vehicles.
Electric Mine and Industrial Locomotives.
Storage Battery Street Cars.

The largest individual users of storage batteries and those operating the largest individual plants are the central lighting and power companies.

At the head of this group stands the New York Edison Company, which has used the batteries manufactured by The Electric Storage Battery Company exclusively for over seventeen years, and which has had installed, in its different stations in New York City, 51 huge batteries of the "Chloride Accumulator" and the "Exide" Stand-by types.

These batteries, referred to in the previous section, represent an outlay of almost $2,500,000, and have a total capacity of 48,146 kilowatt hours. They form the largest storage battery equipment in the world owned and operated by one company.

The next largest user is the Commonwealth Edison Company, of Chicago, which owns and operates another enormous battery equipment, made up exclusively of this Company's product. Their installation consists of 30 batteries, having a total capacity of 24,367 kilowatt hours, and represents an investment of almost $1,500,000.

The Edison Illuminating Company, of Boston, operates 14 large batteries; The Brooklyn Edison Company, 13 batteries, and other lighting companies from San Francisco to Atlanta, Los Angeles to Toronto, make up a total of 256 batteries. The aggregate capacity of all the plants which have been built by this Company for central lighting and power service amounts to 279,265 kilowatts.

For electric railway service 329 large batteries have been built and installed, representing a kilowatt hour capacity of 206,925 at the 3 hour rate.

Six batteries, comprising over 1,400 cells, having a total capacity of 6,700 kilowatts at the 1 hour rate, were installed in 1906 for the New York Central Railroad for operation in connection with the electrification of its Grand Central Terminal.

Enormous installations have also been made for the large steel plants. Prominent among these are the installations for The Indiana Steel Co., at Gary, Indiana; The Lukens Iron & Steel Co. and The Carnegie Steel Co.

The Edgar Thomson plant of the United States Steel Corporation at Braddock, Pa., it should be noted, has the largest cells in the world built for this class of service.

One of the large users of the "Chloride Accumulator" and the "Exide" Battery is the United States Government. Twenty submarine boats of the Navy are equipped with these batteries and a large number of cells have been manufactured for the Government for use in connection with gun firing apparatus on battleships and in coast fortifications.

This Company's batteries are also used on numbers of lightships and channel lights, and have been installed for emergency work in connection with the light and power plants of many forts.

The Government uses the "Chloride Accumulator" for operating its wireless apparatus and the "Exide" Batteries are used in vehicle service by the Post Office Department and the Bureau of Engraving and Printing.

A large exciter battery is installed at the Capitol Building in Washington, D. C., and at the Panama Canal oil switch batteries, made by this Company, are used.

While not a Government expedition, it is interesting to note that the Navy Department has detailed Ensign Fitzhugh Green, U. S. N., and Theodore Allen, an expert electrician, to accompany the "Crocker Land Expedition" to the North Polar regions, which started from New York in July, 1913.

This expedition carried among its scientific and other supplies a battery of "Ironclad-Exide" cells, which is to be used for lighting their permanent headquarters erected on the shores of Flagler Bay.

As outlined in the first section of this book, among the early uses of storage batteries, their application to street car service was mentioned.

It is significant that today, in New York City alone, 183 street cars are operated by the "Hycap-Exide" Battery. The batteries for the first group of fifteen of these cars which went into commission in September, 1911, are still in service and have averaged, up to August, 1913, 26,000 miles per battery.

The Lewisburg, Milton & Watsontown Passenger Railway Co. uses a large battery car as a "feeder" to the railway system over whose tracks it runs for a considerable distance.

Other storage battery cars equipped with "Hycap-Exide" Batteries are operated at Pekin, Ill., Milledgeville, Ga., and Billings, Mont. The storage battery cars equipped with these batteries have conclusively proved their superiority in widely varying conditions of this class of service.

The Marconi Wireless Telegraph Co. has from its early days used the batteries manufactured by this Company and the large stations recently erected at Belmar and New Brunswick, N. J., San Francisco, Cal., and Honolulu, Hawaii, are each equipped with 150 cells of "Chloride Accumulator".

Batteries built for the switch, signal and car lighting work of fifty steam railroads; for over a thousand telephone exchanges—634,216 cells have been manufactured for telegraph, telephone and

signal use; and many thousands of installations covering isolated lighting plants, yacht lighting—490 yachts have been equipped with the "Chloride Accumulator"—oil switch service and electric locomotives, give but a faint idea of the immense output of this Company during the past twenty-five years.

When it comes to giving even an approximation of the extensive distribution of the four famous "Exide" Batteries, words fail.

These batteries have made their name so inseparably associated with the electric vehicle industry, and such enormous quantities of them are manufactured annually that it is permissible to state their use as being universal. The number manufactured and shipped from this factory since the day they were first placed on the market represents a total too huge to accurately compile from thirteen years of vehicle battery manufacturing records.

The only real trouble the "Exide" plates have given since their introduction in 1900 is the difficulty confronting the maker in being compelled constantly to enlarge the factory space devoted to their manufacture, so that the production can keep pace with their ever increasing popularity.

The recent development of the electric starting and lighting apparatus for automobiles has opened a large field for battery service. The promptness with which this Company's resources met the enormous demand for this new form of battery is evidenced in the tens of thousands which are being continually made and shipped.

Probably the following data taken from a memorandum of the shipment of merely one large central station battery will best enable the reader to appreciate the total volume of output from this factory. This battery consisted of:

152 cells in lead lined wood tanks, each cell containing 133 plates—a total of 20,216 plates.
The total weight of the entire battery was 1,079,200 pounds.
52 railway cars were required to transport the battery and its constituent parts.
The floor space covered by the battery is 45 by 116 feet.

In attempting to compile some statistics which would illustrate the enormous output of this factory, it was found that over 100,000,000 pounds of battery material were figured as the total weight which had been manufactured and supplied for simply one class of service. This statistical work was thereupon discontinued.

But it is not the perfection of the battery building art alone, nor the magnitude of its output, which distinguishes this Company

in its twenty-five years of progress. Its history shows it to have been foremost in the field to invent, develop and perfect the various accessory apparatus and the many devices that enlarging uses of storage batteries demanded.

The fertile genius of its engineering force has perfected apparatus which this Company alone controls, thus enabling it to furnish not only the most serviceable battery for every specific requirement, but of equal importance, to build and supply the necessary controlling and regulating apparatus essential to the proper operation and maintenance of the battery after installation.

One of these adjuncts to large battery installations is The E. S. B. Co. Motor Driven End Cell Switch, which has been evolved from the hand operated switch of years past. These huge pieces of controlling apparatus—the largest having a capacity of 40,000 amperes in emergency service—are entirely built in the works of this Company. Pictures of the earliest type of hand operated switch manufactured and the present Motor Driven End Cell Switch are shown in Plate VII. Over 700 of these have been manufactured and installed by this Company.

Many more or less successful attempts have been made to produce a railway car lighting equipment which would satisfactorily meet the exacting requirements of this difficult class of service, but The E. S. B. Co.'s Axle Lighting System has solved the problem.

The success secured from the installation of this apparatus on the cars of one of the Western trunk lines has added to the list of The Electric Storage Battery Company's achievements.

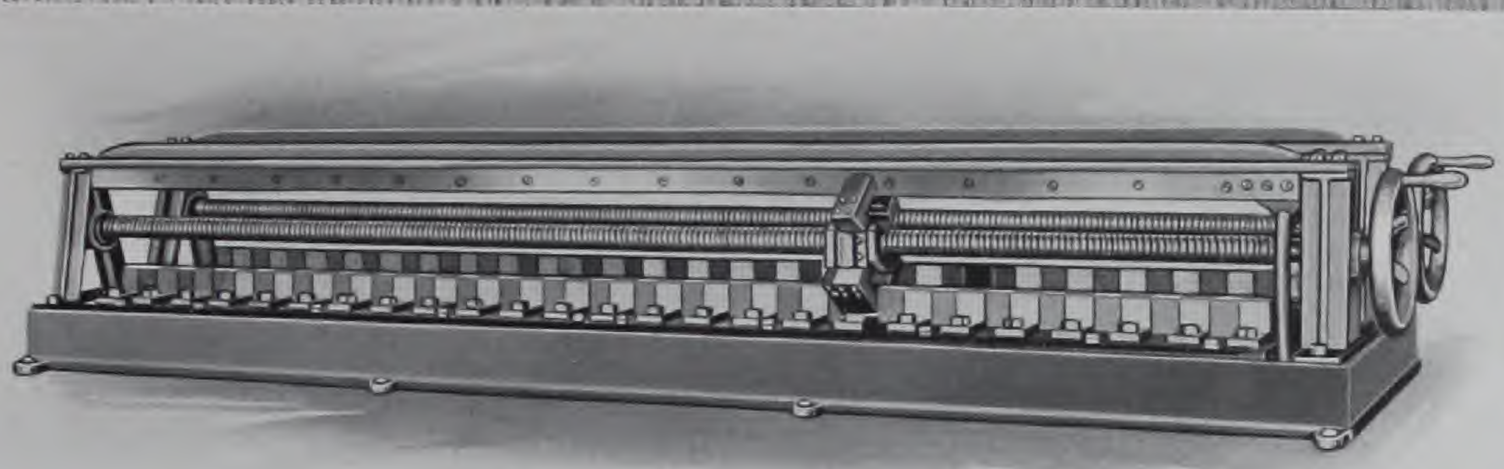
Among other developments of auxiliary apparatus should be mentioned this Company's Carbon Regulator, the Average Adjuster, the Automatic Current Stop and the Cell Indicator.

In the operation of large batteries, many ingenious mechanisms have been perfected to watch with almost human intelligence the condition of the battery installations. The Automatic Water Filler and the Recording-Signaling Hydrometer are among the invaluable appliances which this Company has perfected and alone controls.

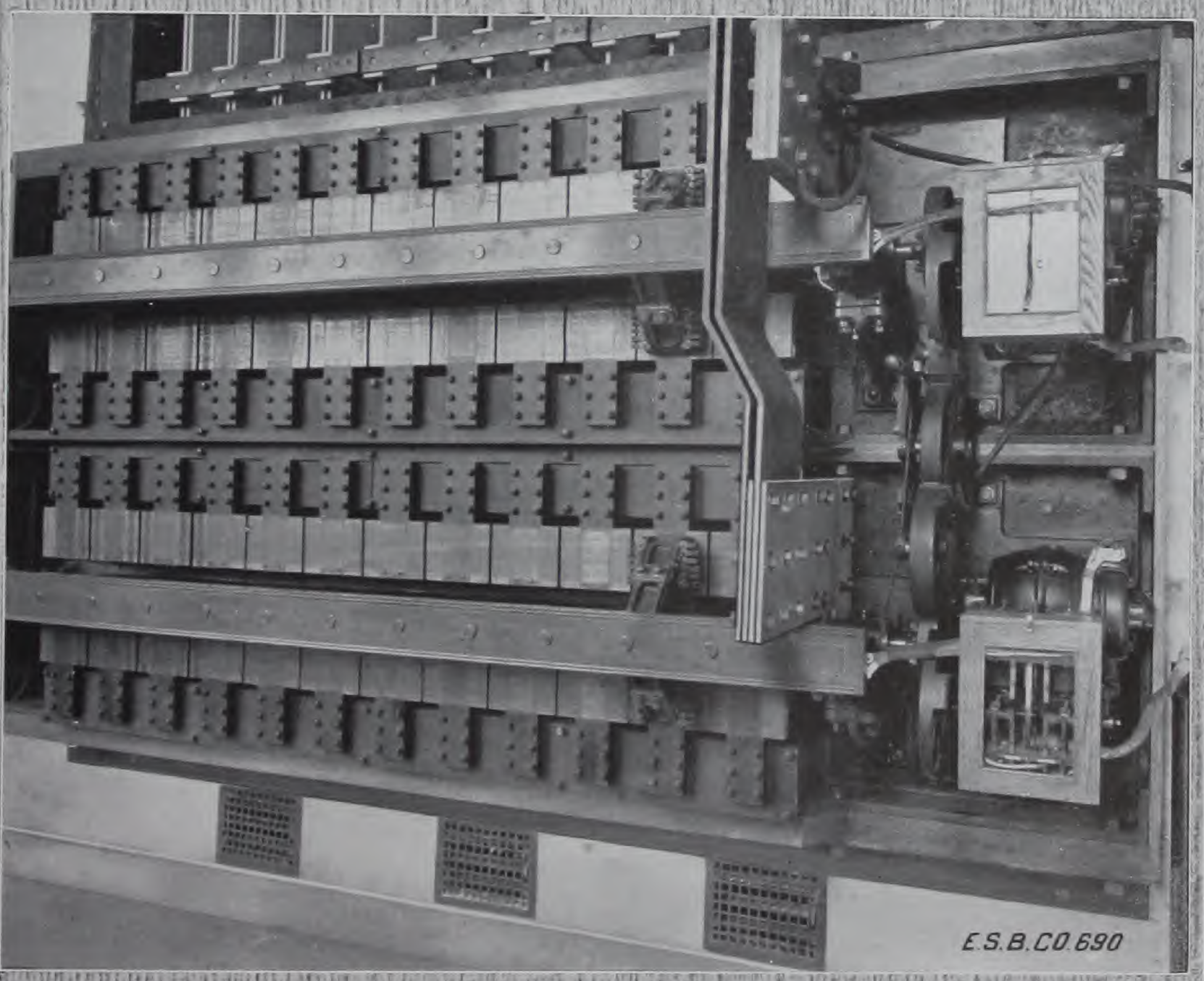
In the details of installing a huge central station battery, many engineering problems arise, and it is of importance to note that this Company has originated, developed, perfected and first put into service all of the really important devices and methods pertaining to the successful installation and maintenance of these large batteries.

The Oil Insulator, developed and standardized by this Company, solved the troublesome question of properly insulating the immense lead lined tanks used in large stationary batteries. The proper

END CELL SWITCHES OF THE PAST AND PRESENT



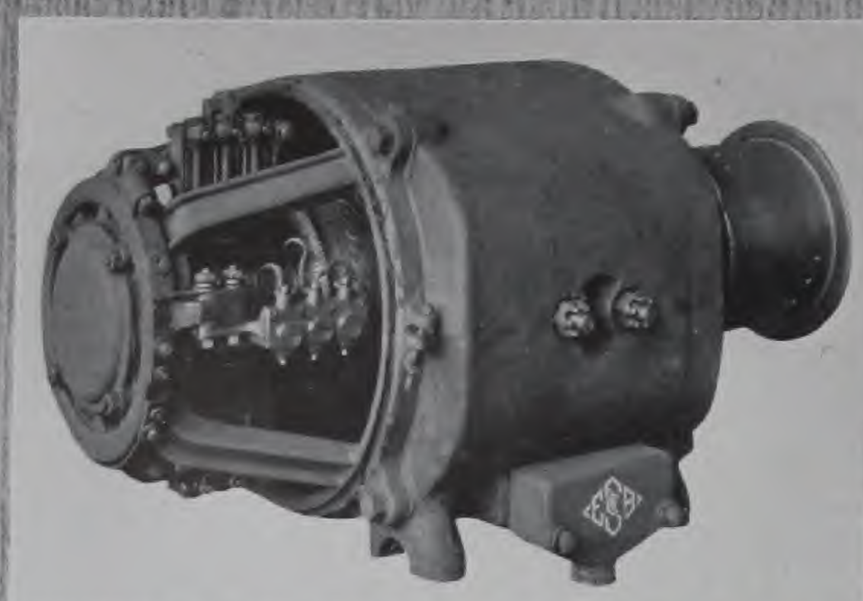
FIRST HAND OPERATED END CELL SWITCH

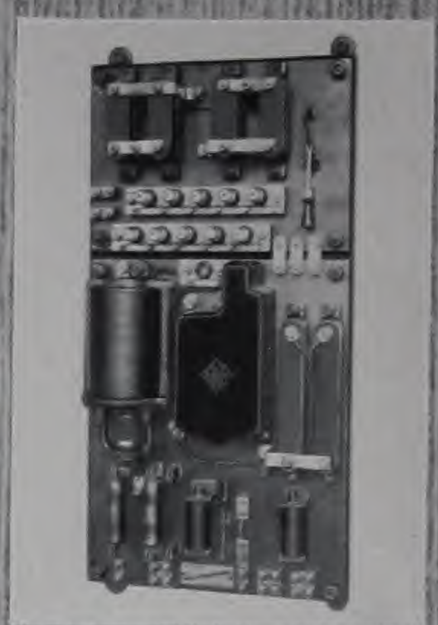


PRESENT MOTOR DRIVEN END CELL SWITCH

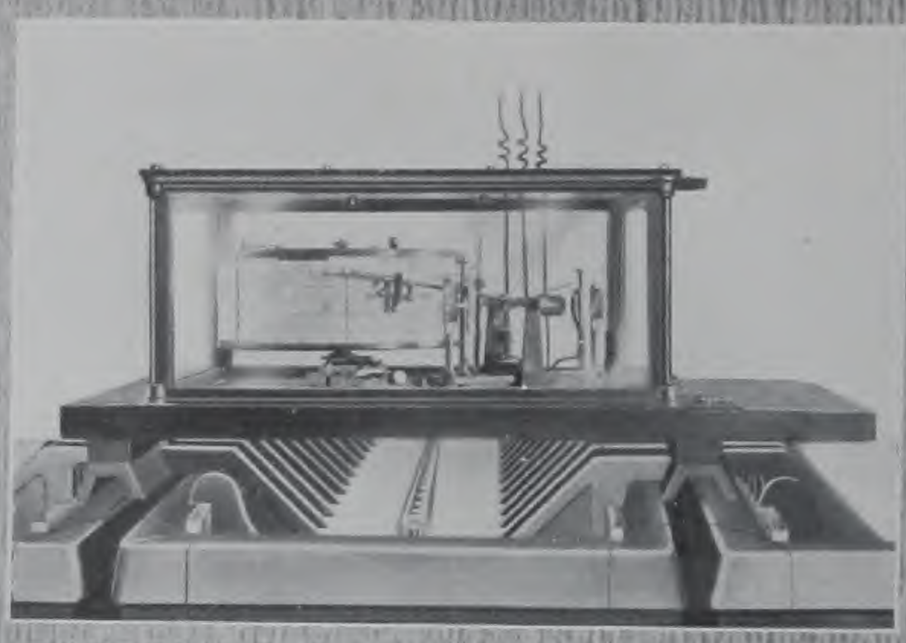
AUXILIARY APPARATUS

DESIGNED AND MANUFACTURED BY THE ELECTRIC STORAGE BATTERY CO.

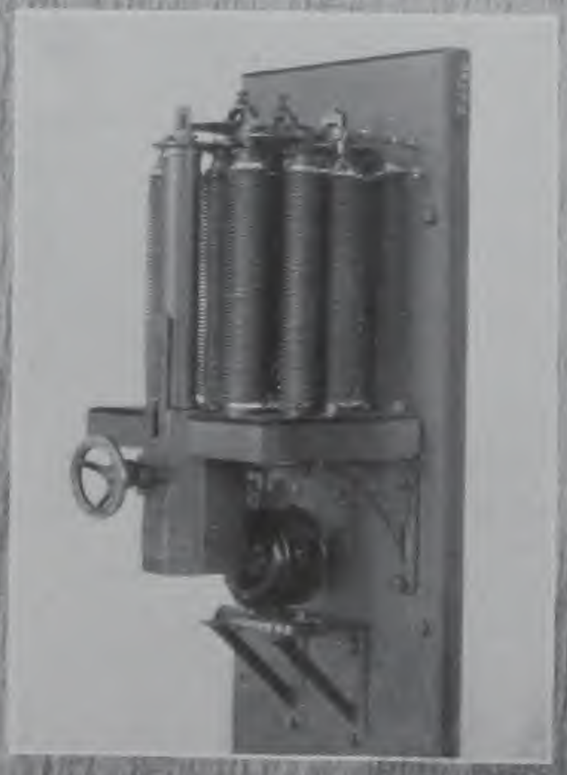




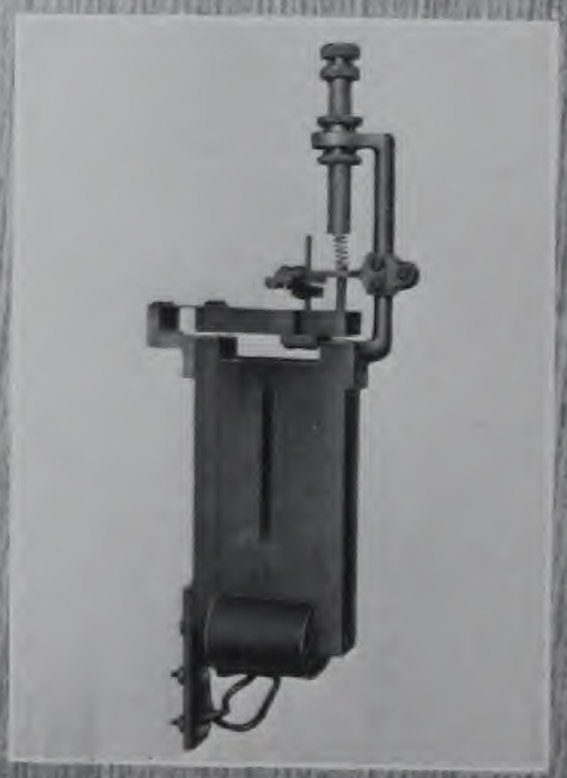
DYNAMO AND SWITCHBOARD FOR THE "E.S.B. AXLE LIGHTING SYSTEM"



RECORDING SIGNALING HYDROMETER



CARBON REGULATOR



AUTOMATIC CURRENT STOP

construction of battery room floors and other details of this character have all been worked out by the Company's force of engineers.

In this way, storage battery practice, as exemplified by The Electric Storage Battery Company's installations, has become the acknowledged standard by the foremost electrical engineers of this country.

In concluding this section, mention could be made in detail of many inventions and improved processes, such as the device for suspending end cell copper; the development of the wood separator, which plays such an important part in the life of batteries; the method of tank construction; the copper reinforced bus bar and other items of equal importance.

But it has been thought that even to enumerate these inventions and accessories would make this chapter read more like a catalogue than a short story of accomplished work.

Doubtless, the inference has already been drawn that this Company's strong point is not in adopting or adapting, but in originating.

And even in this brief sketch the reader may have appreciated just why the batteries manufactured by this Company stand unrivaled and how that acknowledged "uniformity of product" is secured.

Above all else, it has emphasized this Company's adherence to a strict policy of ADOPTING NOTHING UNTIL IT HAS HAD A THOROUGH TRIAL, AND OF MAKING ITS EXPERIMENTS IN THE LABORATORY AND NOT ON THE CUSTOMER.

1888 <ESB> 1913

A CORNER OF THE "MANCHESTER" CASTING ROOM WHERE "MANCHESTER" AND "IRONCLAD - EXIDE" GRIDS ARE MADE

MOULD FOR "MANCHESTER" GRIDS UNDER A PRESS, READY TO RECEIVE ITS CHARGE OF MOLTEN LEAD ALLOY

A "MANCHESTER" TAPE PRESS AT WORK

MAKING BUTTONS FOR "MANCHESTER" GRIDS AND PRESSING THEM INTO POSITION ON THE PLATE

CASTING BOX NEGATIVE GRIDS

1888—1913

The Electric Storage Battery Co.

The Factory

THE transformation of a pig of lead into a storage battery element is such a very interesting process that it is hoped the illustrations accompanying this brief trip through the works will give a fairly clear conception of a few of the many methods employed to perfect this evolution.

Hundreds of tons of these "pigs," as they arrive in car load lots from the Western refiners, are stored on the ground floor of one of the buildings. From these store rooms they are trucked to several departments, where the manufacturing of grids, straps, bus bars, lead ribbon, sheet lead, the lead coating of parts and other manufacturing processes are carried on.

As soon as the car loads of lead and lead alloy arrive, samples from each shipment are sent at once to the chemical laboratory for a careful analysis before any of the metal is allowed to be used in the manufacturing of battery plates or parts.

This chemical laboratory analyzes every run of lead and lead alloy, every keg of lead oxide and every lot of electrolyte. These materials are put through the most rigorous chemical and physical tests by experts in this branch.

The lead alloy which has been approved by the chemical laboratory is taken to a casting room where the grids for the "Manchester" and **"Ironclad-Exide"** plates are made. It is there placed in large melting pots, each holding about 6,000 pounds.

The casting of these grids is the first step in the manufacturing of the "Manchester" and **"Ironclad-Exide"** positive plates.

This casting is an interesting operation and utilizes specially devised apparatus, which, it should be noted, is the invention of the Company's President—Mr. Herbert Lloyd.

Briefly described, the molten lead alloy from these pots, under an air pressure, is forced into a specially constructed hinged mould. The grid thus cast is then trimmed and delivered to the Filling Department.

And this is an appropriate place to call attention to the fact that there are 285 different designs and sizes of battery plates manufactured by this Company. These varying designs are based upon the following types of plate construction:

"Manchester" Positive
"Tudor" Positive
"Exide" Positive
"Hycap-Exide" Positive
"Thin-Exide" Positive
"Ironclad-Exide" Positive
Westinghouse Positive
Box Negative
Shelf Negative
Plante Negative
"Exide" Negative
"Hycap-Exide" Negative
"Thin-Exide" Negative
"Ironclad-Exide" Negative

In another room the "Manchester" tape presses are seen at work. These are massively built pieces of apparatus which take an ingot of pure lead and force it, under a pressure of 400 tons, through narrow dies in the form of lead tape. This tape is then wound on large wood reels to await the next process.

A similar process of manufacture is carried on for the production of lead bus bars.

These bus bars are also made from ingots of pure lead which are placed into the cylinder of a huge hydraulic press and, under a pressure of from 400 to 500 tons, the lead is forced through dies of appropriate size.

The lead, in the shape of a bus bar, flows upward to a platform of sufficient length to hold the largest bus bar which is made. On this platform it is then cut by means of heavy shears into whatever length of bus bar is required.

Passing to another department, we see the "Manchester" lead tape being run through machines which in one operation corrugates the ribbon, cuts it to the required length and rolls it into a "button" or rosette of the exact size to fit the holes in the cast grids.

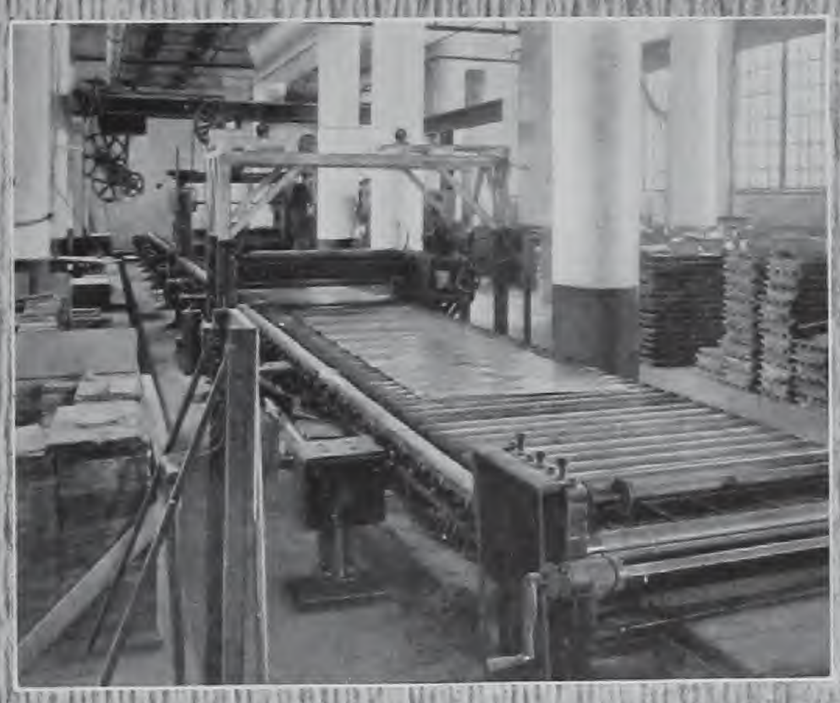
The holes in the grids are then filled with these buttons and the plates passed to adjoining presses which center and force the buttons partly into the holes. Other hydraulic machines press and rivet the buttons permanently into place. The plates are then ready for forming, a process which will be shown later.

In another room a somewhat similar process of grid casting to that seen in the "Manchester" casting room is being carried on. Grids for the box negative plates are seen being cast under pressure in this room.

Passing on, we find another casting room where the manufacturing of the "Exide" grids and the casting of "Tudor" plates is

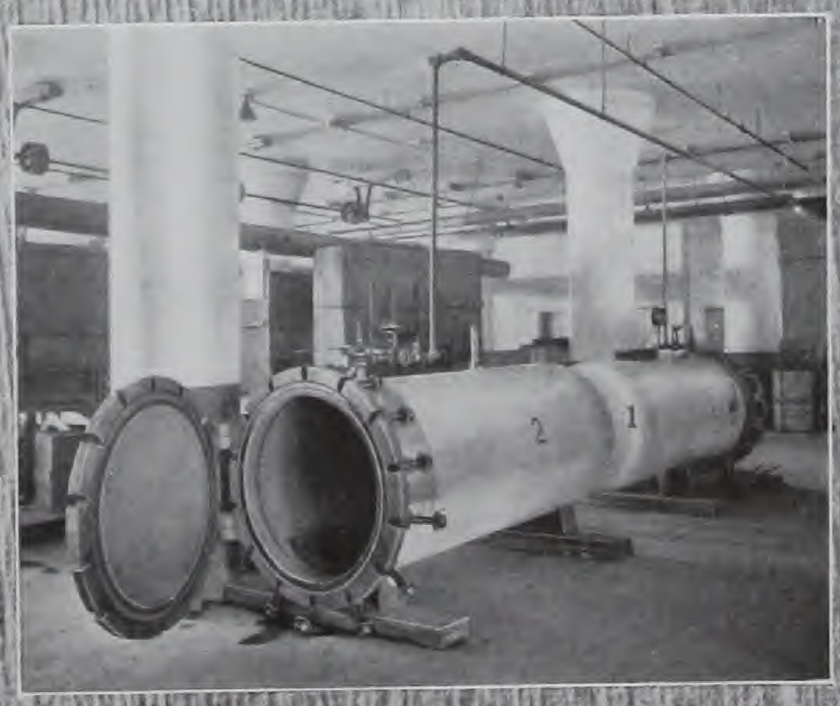
CASTING "EXIDE" GRIDS AND "TUDOR" PLATES

CASTING SMALL LEAD PARTS



ROLLING SHEET LEAD FOR TANK LININGS AND FOR BOX PLATES

CORNER OF THE ROOM WHERE "EXIDE" GRIDS ARE PASTED



APPARATUS FOR VULCANIZING, "IRONCLAD-EXIDE" DEPARTMENT

done by a ladling process. The casting of plates of this type with their fine ribs is an operation requiring much skill. Not only must the composition of the metal be just right, but the temperature must be carefully adjusted.

This process is one of many in storage battery making which exemplifies the value of possessing a force of men having had long experience, those who from years of practice have learned the many little "kinks" and the skill in manipulation which produce perfect castings.

Other casting furnaces are utilized for the making of straps, terminals and other small lead parts used in storage battery building.

Retracing our steps, we again find pigs of pure lead stacked in a large room which is devoted to the rolling of sheet lead. These long sheets of lead are utilized for the lining of the huge tanks used for the cells installed in lighting and power stations and for car lighting and other battery tanks. The sheet lead is also used in the making of "box" plates.

The rolling mill in this room is 150 feet long. It was specially designed for this process and is the largest in the country.

In another portion of the factory, we find a room which is used for pasting "Exide" plates. The composition of the "pastes" used in this process is the result of years of most painstaking experiments. Not only are the constituents carefully analyzed, but the mixing is carried out and supervised by men who are thoroughly experienced in this work.

Tens of thousands of plates are pasted in these rooms every day. Here again is found that invaluable asset of expert workmen whose skill secures that "uniformity of product" which makes this Company's batteries distinctive.

Passing along, we come to the rooms where the famous "Ironclad-Exide" vehicle plates are under process of construction. The large cylinders seen in one section of this department are used in the vulcanizing processes employed in the manufacturing of this plate.

The apparatus used for slotting the tubes of the "Ironclad" positive plate is most intricate and delicate, and requires great care in operation. Each of the slots in the tube is cut by a small saw, 660 cuts per foot are made and many thousands of feet of tube are cut daily.

These tubes are then placed on the grids and filled with active material by specially devised machines. After this a lead strip is burned on the bottom and the plate is then ready for the forming process.

In this way, we have sketched some of the first few processes employed in the making of storage battery plates.

SLOTTING THE TUBES FOR THE "IRONCLAD-EXIDE" POSITIVE PLATES

WHERE "IRONCLAD" GRIDS ARE FILLED WITH ACTIVE MATERIAL

A PORTION OF THE LARGE FORMING ROOM FOR "MANCHESTER" AND "TUDOR" PLATES

FORMING ROOM FOR "EXIDE" PLATES

ANOTHER ROOM FOR FORMING "EXIDE" PLATES

A CORNER OF THE COMMERCIAL LABORATORY

As we resume our walk around the works, we come to a department which takes the manufactured plates, which, from a mechanical standpoint, have been completed, and puts them through the process of "forming."

The first room we enter is a large Forming Room, where "Manchester" and "Tudor" plates of various sizes are going through this electrochemical process, a detail which has been perfected by this Company through much experimenting and which demands careful supervision by experienced foremen.

Continuing, we pass through two other buildings, both of which are devoted to the forming of "Exide" plates. In these rooms can be seen thousands of plates being handled at one operation.

Several other operations follow this process, after which the plates are ready for testing. A large number of samples from each day's run are forwarded from these Forming Rooms to the Commercial Laboratory, which we next visit.

The Commercial Laboratory is a department maintained for the express purpose of insuring the greatest possible uniformity of product.

To this end, there are sent to this department sample plates from every lot which passes through the Forming Room, and these samples are subjected to rigid tests to insure their electrical properties being up to the standard.

After this the plates are removed from the test cells and carefully inspected to be sure that they are right physically.

As a result of these tests, defects are occasionally discovered, causing plates to be condemned which, but for these precautions, would have been considered up to standard and delivered to customers as such.

After going through the Forming Rooms and after having passed the tests and inspections, the plates are transferred to the Assembling Department. Entering one sub-department of this section, the "Exide" Starting and Lighting Batteries are found approaching completion, and in another subsection "Manchester" and Box plates are seen in process of being assembled in groups.

Before proceeding further, it is well to retrace our steps so that we can see some of the manufacturing departments which are occupied in the preparation of the sundry receptacles and fittings employed in the building up of a complete battery.

The first place to visit will be the Wood Working Department, whose machinery occupies the entire fourth floor of the main manufacturing building.

ASSEMBLING "EXIDE" STARTING AND LIGHTING BATTERIES

ASSEMBLING STATIONARY BATTERIES. "MANCHESTER" AND BOX PLATES BEING BURNED INTO GROUPS.

A SMALL CORNER IN THE WOOD WORKING DEPARTMENT

CUTTING AND GROOVING WOOD SEPARATORS

MACHINES FOR MAKING MOULDS

MACHINERY USED IN THE CONSTRUCTION OF MOTOR DRIVEN END CELL SWITCHES

Here are built those huge wood tanks, 150 or more of which are required for every installation for central station lighting and power plants. The numerous trays and crates required for vehicle batteries and the cases for auto starting and lighting batteries are made here. Other important wood working is also done in this room.

In one section of this department are seen the machines used for cutting and grooving the countless thousands of wood separators which are used in assembling the various types of batteries.

The wood separators, when made, are transferred to a room where they are placed in large vats to be treated by a special process before being delivered to the Assembling Room or shipped to the "Exide" Depots. This patented process is most important, as it is the only known method by which the injurious acids contained in the wood can be successfully removed.

The Machine Shops of this Company are very extensive. This is partly due to the fact that a great deal of the machinery and many of the tools used throughout the works are specially designed for their particular purpose by the Company's engineers. This necessitates the making in these machine shops numbers of moulds and dies.

As we enter the room, we see machinists at work in that portion of the Machine Shop utilized for this purpose, and in another section we note some of the iron planers used in building the giant motor driven end cell switches.

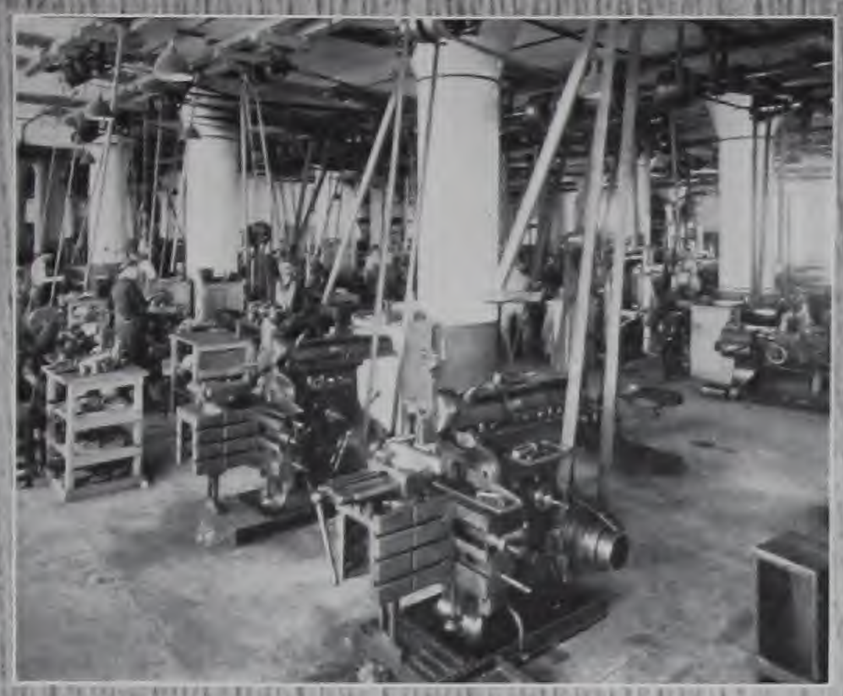
Some of the sheet lead which we saw going through the large lead rolling mill at the beginning of our trip is found in the next room we enter.

Here it is being cut to the proper dimension for lining the wood battery tanks. In another section of this room, we see these tanks in process of being lined and note the huge size of a number of them which are destined for a central station installation.

Passing to another department, we find the tanks employed for electroplating. The innumerable bolts, washers, terminals, copper connectors and other material are brought here to be coated with lead to prevent corrosion from acid fumes.

On another floor, we enter a large room devoted to the initial charging of the various types of ignition, starting and lighting, vehicle and other portable batteries. Unusually large switchboards control the current supplied to various sections of this room.

Incidentally, one of these switchboards of 80 circuits is the largest battery charging switchboard in the country, having a capacity



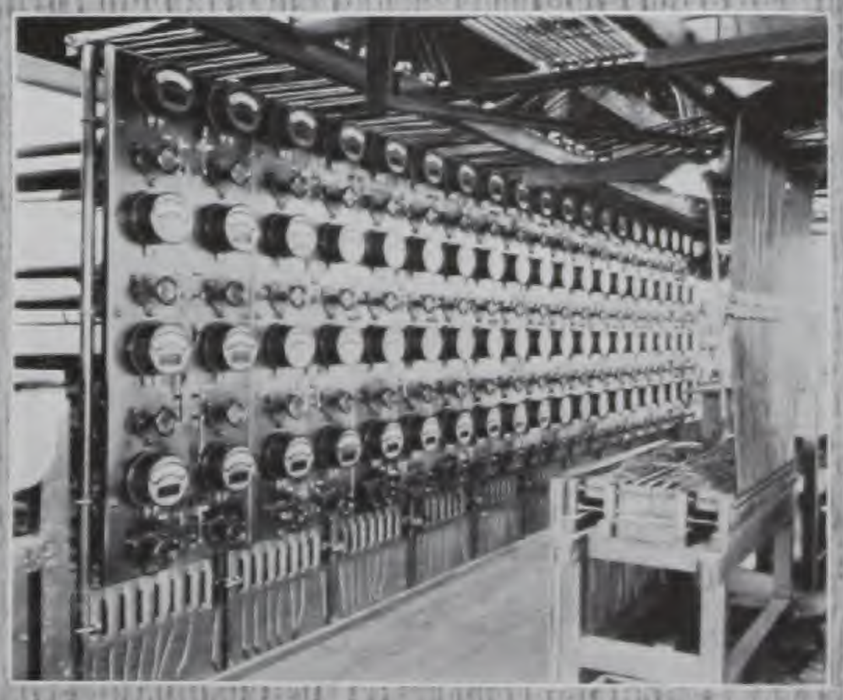
ANOTHER VIEW OF THE MACHINE SHOP

CUTTING SHEET LEAD FOR TANK LINING

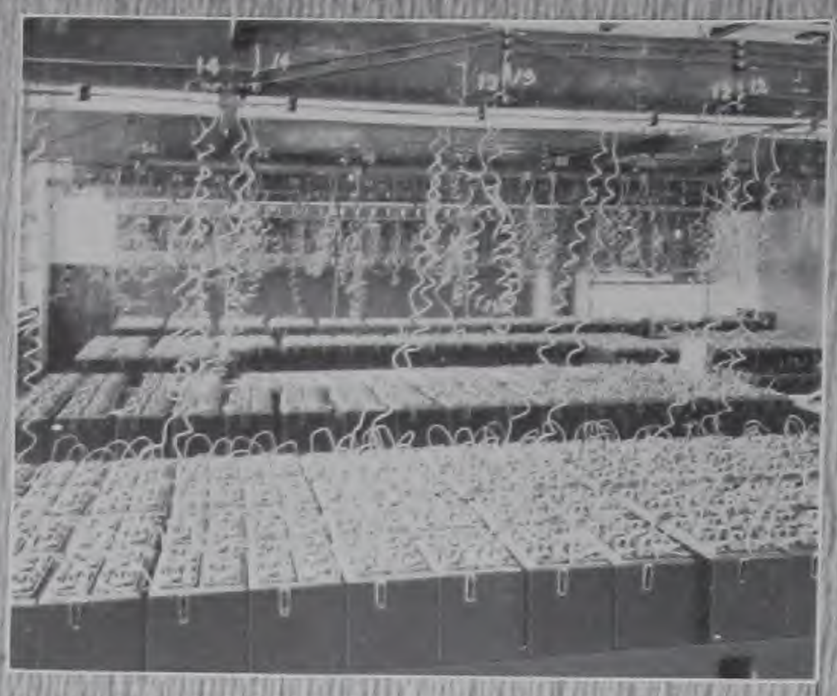
LEAD BURNING AND LINING OF TANKS

TREATING WOOD SEPARATORS

ELECTROPLATING DEPARTMENT



THE LARGE BATTERY CHARGING SWITCHBOARD



ONE CORNER OF THE BATTERY CHARGING ROOM

CHARGING "EXIDE" SPARKING BATTERIES

VARNISHING AND LACQUERING ROOM

A CORNER OF THE SHIPPING ROOM

ELECTRIC TRUCKS BEING LOADED AT SHIPPING PLATFORM

GENERAL VIEW OF THE SHIPPING PLATFORMS

sufficient to charge 3,200 vehicle cells at one time. Other switchboards in this room, representing 145 circuits in all, make up a total sufficient to charge 10,160 cells at one time.

The battery boxes and crates before shipment receive their final varnishing and lacquering in a room set apart for this purpose.

The entire first floor of one wing is used by the Receiving and Shipping Departments. In one portion, machines are seen preparing and cutting lumber to the proper size for making packing boxes and crates. Two large box making machines in another section of this room are employed in rapidly turning them out in the various sizes required.

The Receiving Department, with its platform and railroad siding, occupies the western end of this floor, and the Shipping Department, with extensive platforms, uses the eastern end. These loading platforms have tracks directly connected with two large trunk lines—the Pennsylvania Railroad and the Philadelphia & Reading Railway Co.

A word should be added before closing this chapter in reference to the careful consideration which has been given, in planning the new manufacturing building, to the comfort and welfare of the workmen employed in the various departments.

The novel "mushroom system" of reinforced concrete construction permits of a flat, unobstructed ceiling with no girders or rafters to obstruct the air or light. With high and broad windows, an abundance of light and air reaches every portion of the building, so that artificial light is seldom required even during cloudy days.

Every workman is given an individual metal locker for his clothes. Well equipped shower bath rooms, an abundance of wash stands and the most modern and sanitary toilet fixtures throughout the building are at his disposal.

A popular feature has been the institution of a dining room where those who desire a substantial, freshly prepared hot dinner can obtain it for a merely nominal sum.

Smoking and reading rooms adjoin this dining room, where the men can enjoy their pipes and papers during the noon hour in winter months, while an inclosed section of the roof is at their disposal in seasonable weather for noon hour recreation.

An athletic association has been successfully conducted for several years, the uniformed base ball and basket ball teams being particularly strong organizations. Their Saturday schedule of base ball games with similar aggregations from the manufacturing establishments in the neighborhood has shown this team to be a formidable one.

E. S. B. CO. BASE BALL TEAM
1913 CHAMPIONS OF THE INDUSTRIAL LEAGUE

E.S.B CO. BASKET BALL TEAM

The championship of "The Industrial League" for 1913 was won by the club, and it is the proud possessor of the handsome silver cup shown in the group picture of the team.

A room in the new building, which will seat about 500, has been set apart for general entertainment, and more especially for the institution of a feature which, it is confidently expected, will further promote the interests of the Company's employees.

It is proposed to inaugurate, during the coming winter, a series of popular lectures or informal talks, illustrated by lantern slides, upon the application of storage batteries to various fields of service.

To this end, a number of the Company's engineers have been selected to deliver these talks at weekly intervals after the close of business on the appointed day. The object sought is to interest the employees by showing them how the batteries, which they have helped to manufacture, are used after they are shipped from the factory and to give the men an idea of the important part the storage battery plays in the electrical industry.

THE ACCOUNTING ROOM

A PORTION OF THE CONSTRUCTION DEPARTMENT
DRAFTING ROOM.

1888—1913

The Electric Storage Battery Co.

The Organization

CORPORATION OFFICERS

HERBERT LLOYD
President

GRANT B. SCHLEY
First Vice President

JOHN R. WILLIAMS
Second Vice President

CHARLES BLIZARD
Third Vice President

BRUCE FORD
Fourth Vice President

WALTER G. HENDERSON
Secretary and Treasurer

JOHN P. FITZGERALD
Assistant Secretary and Treasurer

BOARD OF DIRECTORS

HERBERT LLOYD

GRANT B. SCHLEY

KENNETH B. SCHLEY

P. A. B. WIDENER

RUDULPH ELLIS

ALEXANDER C. HUMPHREYS

WM. D. WINSOR

JOHN R. WILLIAMS

N. F. BRADY


Grant Buckley
FIRST VICE PRESIDENT
John P. Williams
SECOND VICE PRESIDENT
Thomas Blyzard
THIRD VICE PRESIDENT
Bruce Ford
FOURTH VICE PRESIDENT
Walter Buckley
SECRETARY AND TREASURER

OFFICERS, DEPARTMENT HEADS, ENGINEERS AND SALES STAFF

1888. Herbert Lloyd
President and General Manager

1895. John R. Williams
Second Vice President, in Charge of Maintenance and Operating

1893. Charles Blizard
Third Vice President, in Charge of Sales Department

1899. Bruce Ford
Fourth Vice President, in Charge of Technical Department

1897. Walter G. Henderson
Secretary and Treasurer

1897. John P. Fitzgerald
Assistant Secretary and Treasurer

1893. Augustus B. Stoughton
General Counsel

1895. C. Wendell Woodward
Assistant to the General Manager

1890. William Taylor
In Charge Experimental Laboratory

1893. Carl H. Reed
Manager Advertising Department

1894. Carroll Hodge
Manager Construction Department and Exide Depots

1894. H. B. Montgomery
Engineer Operating Department, Philadelphia

1895. Frank J. Stone
Manager Boston Sales Office

1895. Hugh Lesley
Engineer in Charge Operating Dept.

1895. Edward G. Steinmetz
Factory Superintendent

1895. George M. Howard
Chief Chemist

1895. H. M. Beck
Engineer Operating Department, Chicago

1895. Charles Peary
Traffic Manager

1895. F. B. Neely
Philadelphia Sales Office

1895. W. O. Knudsen
New York Sales Office

1895. A. Adam
Engineer Philadelphia Construction Department

1896. Cornelius Ambruster
Engineer Construction Department

1896. J. W. Achard
Chief Draftsman Construction Dept.

1896. W. Y. Kelly
In Charge Chemical Laboratory

1897. Edward W. Smith
Factory Engineer

1897. G. H. Morris
Engineer Chicago Construction Dept.

1897. William C. DuBois
Private Secretary to the President

1898. J. Lester Woodbridge
Chief Engineer

1898. Albert Taylor
Manager New York Sales Office

1898. Joseph L. Phillips
Assistant Factory Superintendent

1898. A. V. Morris
Engineer Operating Department

1898. Elwood Cadwallader
In Charge Estimating Department

1898. F. H. Knorr
Chief of Production Order Dept.

1898. Thomas L. Hammersley
Chief Clerk Construction Department

1898. Herbert Brokenshaw
In Charge Filing and Mailing Dept.

1899. Edward L. Reynolds
Manager Pa. Sales Office

1899. J. H. Tracy
Assistant Chief Engineer

1899. Frank T. Kalas
Pa. Sales Office

1899. G. P. Brick
Auditor

1899. O. R. Shortall
Construction Department Engineer


ASST. SECRETARY AND TREASURER
ASST. TO THE GENERAL MANAGER
Augustus B. Stoughton
GENERAL COUNSEL
MANAGER OF ADVERTISING DEPT.
CHIEF ENGINEER


MANAGER OF CONSTRUCTION
ENGINEER IN CHARGE OF OPERATING DEPT
IN CHARGE OF EXPERIMENTAL LABORATORY
FACTORY SUPERINTENDENT
PURCHASING AGENT

Plate XIX

Officers, Department Heads, Engineers and Sales Staff—Continued

1900. Samuel M. Nicholas
Assistant Manager Sales Department

1900. George R. Murphy
Manager Battery Department, San Francisco Office

1900. Charles W. Terry
Manager Detroit Sales Office

1900. William B. Gold
Purchasing Agent

1900. John W. Cooke
Engineer Boston Sales and Operating Department

1900. H. E. Hunt
Engineer Operating Department, Philadelphia

1900. Francis H. Kent
Chief Inspector

1901. H. B. Gay
Manager Cleveland Sales Office

1901. F. L. Kellogg
New York Sales Office

1901. R. S. Garton
Engineer New York Construction Department

1901. W. G. Bardens
Engineer San Francisco Construction and Operating Departments

1901. E. L. Longaker
Chief Draftsman Department of Development and Design

1901. W. W. McMahon
Philadelphia Sales Office

1902. Godfrey H. Atkin
Manager Chicago Sales Office

1902. R. A. Whetstone
Engineer

1902. G. M. Mintzer
Chief Clerk Cleveland Exide Battery Depot

1903. C. J. Welcke
Engineer Operating Department, New York

1903. A. B. Burk, Jr.
Engineer Cleveland Exide Battery Depot

1903. T. H. Dooling
San Francisco Office

1904. George Neth
Superintendent Exide Battery Depot

1904. W. Creitz
In Charge Commercial Laboratory

1904. J. Gallagher
Engineer Chicago Exide Battery Depot

1905. H. B. Marshall
Contract Agent St. Louis Sales Office

1905. F. G. Beetem
Engineer

1905. H. F. Sauer
Cleveland Sales Office

1905. R. W. Taylor
Boston Sales Office

1905. F. F. Acker
Assistant Auditor

1905. M. A. Stauder
Cleveland Sales Office

1906. Talliaferro Milton
District Engineer Chicago Sales Office

1906. F. C. Brockmeier
St. Louis Office

1906. Franklin H. Willey
Chief Clerk Purchasing Department

1907. George D. Luther
Contract Agent Denver Sales Office

1907. A. N. Bentley
Manager Atlanta Sales Office

1907. Charles W. Bell
Atlanta Sales Office

1907. C. K. Johnson
Engineer N. Y. Exide Battery Depot

1907. Paul Rebel
Chicago Sales Office

1907. W. C. Smith
Chief Clerk Chicago Exide Battery Depot

1907. A. F. Charlton
Engineer Cleveland Exide Battery Depot

1908. A. Gowans
Engineer Boston Exide Battery Depot

1908. H. D. Evans
Cashier

1908. D. M. Simpson
Assistant Superintendent Exide Battery Depots

1908. J. N. Rosholt
Chicago Sales Office

1908. Roland Whitehouse
New York Sales Office


MANAGER OF CLEVELAND SALES OFFICE
MANAGER OF CHICAGO SALES OFFICE
MANAGER OF BOSTON SALES OFFICE
MANAGER OF NEW YORK SALES OFFICE
CONTRACT AGENT, ST. LOUIS SALES OFFICE
MANAGER OF PENNSYLVANIA SALES OFFICE


Chas W Ferry
MANAGER DETROIT SALES OFFICE
C. H. Burtsma
MANAGER ATLANTA SALES OFFICE
R. N. Richards
MANAGER LOS ANGELES OFFICE
George D. Linton
CONTRACT AGENT
DENVER SALES OFFICE
George L. Murphy
MANAGER BATTERY DEPT.
SAN FRANCISCO OFFICE
H. B. Silver
MANAGER SEATTLE OFFICE
MANAGER PORTLAND ORE. OFFICE

Officers, Department Heads, Engineers and Sales Staff—Continued

1909. W. B. Bowie
New York Sales Office

1909. T. A. Cressey
Chicago Sales Office

1909. R. I. Baird
Chicago Sales Office

1909. William M. Ely
Cleveland Sales Office

1909. C. Brushwitz
Engineer Atlanta Exide Battery Depot

1909. H. S. Marsh
Engineer San Francisco Exide Battery Depot

1910. W. H. Palmer
Assistant Engineer

1910. Cameron H. Bristol
Assistant Manager Advertising Dept.

1910. D. P. Orcutt
New York Sales Office

1910. C. W. Chappelle
Engineer Cleveland Sales Office

1910. P. G. Downton
Chicago Sales Office

1910. L. H. Flanders
Assistant Engineer Department of Development and Design

1910. H. M. Baumgartner
Cleveland Sales Office

1910. C. G. Gauntlett
San Francisco Office

1910. R. H. Husbands
Manager Los Angeles Office

1910. S. Herbert Lanyon
Manager Portland, Ore., Office

1910. N. H. Silver
Manager Seattle Office

1910. C. J. Hawkes
Engineer Denver Exide Battery Depot

1910. Clarence Kaeber
Chief Clerk Credit Department

1910. J. B. Gregory
Engineer St. Louis Exide Battery Depot

1910. E. J. Weinheimer
Denver Sales Office

1910. A. M. Dingee
Philadelphia Sales Office

1910. C. B. Raymond
Boston Sales Office

1910. Harold G. Carron
Detroit Sales Office

1910. W. P. Roche
Cleveland Sales Office

1911. P. R. Moffett
Cleveland Sales Office

1912. W. F. Rath
Los Angeles Office

1912. T. B. Greening
Detroit Sales Office

1912. W. Van C. Brant
Pa. Sales Office

1912. D. B. Parker
Chicago Sales Office

1912. F. B. Owens
Portland, Ore., Office

1913. A. W. Hill
Atlanta Sales Office

1913. W. R. Hamilton
Seattle Office

1913. Frederick J. Shepard, Jr.
Boston Sales Office

1913. C. L. Boice
Detroit Sales Office

Frederic Nicholls
President Canadian General Electric Co., Ltd.
Sales Agents for Canada

Albert E. Wilkes
Canadian General Electric Co., Ltd.
Storage Battery Section

H. R. Noack
President Pierson, Roeding & Co.
Pacific Coast Selling Agents

Thomas Finigan
Vice President Pierson, Roeding & Co.
Pacific Coast Selling Agents

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